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## Fluctuation and phase transition in amorphous FeGe thin film

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The question of fluctuation and population growth at the local level and how that influences global properties has been studied extensively in physical, biological and social sciences. In quantum material interplay of fluctuation and phase transitions provide deep insight into the phase transition pathways. Using coherent x-ray scattering we have shown that phase transition in amorphous FeGe (a-FeGe) involve existence of nanoscale fluctuation “hot-spots” whose origin lies in local non-equilibrium states. The fluctuating hot spots start over a small fraction of the domains at random length scales, and the fluctuating population gradually grows non-linearly into collective fluctuations. The growth of the fluctuation population resembles dynamic coherence length which forms the basis of phase transition. We further showed that there exists a highly non-trivial fluctuating phase that can be described as a helical nematic phase. We also studied the distribution of the fluctuation amplitude and it followed a gaussian distribution implying ergodic dynamics whereas few kelvins below this transition temperature the distribution becomes skewed or asymmetric due to non-ergodic behavior. We also showed that our approach provides a new way to evaluate the statistics of the fluctuations in many classes of heterogeneous materials. Work is funded by U.S. DOE.

[1]. A. Singh, et al. , Adv. Funct. Mater. (2023), 2300224

[2]. A. Singh, et al. , Phys. Rev. B 110, L220406 (2024)

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